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APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE:	WHEELEND ASSEMBLY WITH DETACHABLE OUTBOARD JOINT
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WHEELEND ASSEMBLY WITH DETACHABLE OUTBOARD JOINT

FIELD OF INVENTION

[0001] The invention relates to a wheel end assembly for a motor vehicle that features a self retained, pre-loaded wheel bearing and a detachable outboard joint which can be removed from the wheel end assembly without allowing the wheel bearing to come apart.

BACKGROUND OF THE INVENTION

[0002] In current wheel end designs, an outboard joint includes a stem that is inserted into a hub to transmit rotational power across the wheel end assembly. In these designs, the wheel bearing is not self-retained. Therefore, if the outboard joint is removed from the wheel end assembly, the wheel bearing inner race may separate from the bearing assembly. Additionally, these designs do not eliminate backlash, and therefore, the loads that they can transmit are limited.

[0003] Accordingly, there is a need for a wheel end assembly featuring a self retained wheel bearing and a detachable outboard joint, wherein the outboard joint can be removed from the wheel end assembly leaving the wheel bearing intact.

BRIEF SUMMARY OF THE INVENTION

[0004] In meeting the above need and in over coming the limitations of the known designs a wheel end assembly is provided having a bearing shaft with an inboard end and an outboard end. A wheel hub is mounted onto the outboard end and a detachable outboard joint is mounted onto the inboard end. Mounted onto the bearing shaft between the inboard end and the outboard end is a wheel bearing. The inboard end includes a flange portion that supports the wheel bearing on the

bearing shaft and induces a pre-load into the wheel bearing such that the pre-load is maintained on the wheel bearing when the outboard joint is removed from the wheel end assembly.

[0005] In one aspect the wheel bearing includes a knuckle flange that is adapted to connect the wheel end assembly within a vehicle. The knuckle flange has an inner diameter that defines an inboard outer race and an outboard outer race. The bearing shaft supports an inboard inner race and an outboard inner race. A plurality of bearing elements are positioned between the knuckle flange and the bearing shaft with a first portion of the bearing elements being positioned between the inboard outer race and the inboard inner race and a second portion of the bearing elements being positioned between the outboard outer race and the outboard inner race. The flange portion of the bearing shaft engages the inboard inner race to support the wheel bearing and induces a pre-load into the wheel bearing.

[0006] In another aspect, the outboard joint includes a bell housing having a narrowed neck portion that defines a bell housing inner surface having a polygon shape. The bearing shaft includes an outer surface at the inboard end having a polygon shape corresponding to the bell housing inner diameter. The bell housing engages the bearing shaft and rotationally locks the bell housing and the bearing shaft to one another.

[0007] In yet another aspect, the polygonal shaped bell housing inner surface and the polygonal shaped outer surface of the bearing shaft are tapered along a longitudinal axis of the wheel end assembly.

[0008] In a further aspect, the polygon shaped outer surface of the bearing shaft is formed within the flange portion of the bearing shaft.

[0009] In yet another aspect, the polygon shaped outer surface of the bearing shaft is formed within a ring that is mounted on the bearing shaft. The ring includes a splined inner diameter that engages the outer diameter of the bearing shaft such that the ring is rotationally locked onto the bearing shaft.

[0010] In still another aspect, the ring includes an inboard face having a plurality of axial extending ridges, wherein the flange portion of the bearing shaft engages the axially extending ridges such that the ring is rotationally locked onto the bearing shaft.

[0011] Additional features, benefits, and advantages will become apparent to those skilled in the art to which the invention relates, from a review of the subsequent description and the appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Figure 1 is a side sectional view of a wheel end assembly;

[0013] Figure 2 is a side sectional view, similar to Figure 1, of a variation of the wheel end assembly;

[0014] Figure 3 is a sectional view taken along line 3-3 of Figure 1;

[0015] Figure 4 is an enlarged view of a portion of Figure 1 enclosed within circle 4 shown in Figure 1;

[0016] Figure 5 is a side sectional view of a bell housing of the wheel end assembly;

[0017] Figure 6 is a sectional view taken along line 6-6 of Figure 5;

[0018] Figure 7 is a top view of a retaining clip;

[0019] Figure 8 is a sectional view taken along line 8-8 of Figure 1;

[0020] Figure 9 is an end view of an alternative bell housing;

[0021] Figure 10 is a sectional view of the bell housing shown in Figure 9 taken along line 10-10 of Figure 9;

[0022] Figure 11 is a top view of a retaining ring;

[0023] Figure 12 is a sectional view similar to Figure 8 of a wheel end assembly incorporating the bell housing and retaining ring shown in Figures 9, 10, and 11;

[0024] Figure 13 is a side sectional view of an alternate embodiment of the wheel end assembly;

[0025] Figure 14 is a top view of a ring of the wheel end assembly shown in Figure 13;

[0026] Figure 15 is a side sectional view taken along line 15-15 of Figure 14;

[0027] Figure 16 is a top view of a ring having axial ridges;

[0028] Figure 17 is a side sectional view taken along line 17-17 of Figure 16;

[0029] Figure 18 is a sectional view taken along line 18-18 of Figure 3; and

[0030] Figure 19 is a sectional view similar to Figure 18 of a wheel end assembly incorporating the bell housing and retaining ring shown in Figures 9, 10, and 11.

DETAILED DESCRIPTION OF THE INVENTION

[0031] Referring to Figure 1, a wheel end assembly for a motor vehicle is shown generally at 10. The wheel end assembly 10 includes a bearing shaft 12 having an inboard end 14 and an outboard end 16. A wheel hub 18 is mounted to the outboard

end 16 of the bearing shaft 12 and a detachable outboard joint 20 is mounted onto the inboard end 14 of the bearing shaft 12.

[0032] A plurality of wheel studs 22 extend from the wheel hub 18. The wheel studs 22 are adapted to engage a wheel (not shown) and support the wheel on the wheel hub 18. The outboard joint 20 connects an axle half shaft 24 to the wheel end assembly 10 such that rotational movement is transferred through the axle half shaft 24 to the wheel end assembly 10. The outboard joint 20 is a joint that is adapted to allow angular deflection between the wheel end assembly 10 and the axle half shaft 24, such as a constant velocity joint.

[0033] A wheel bearing 26 is mounted on the bearing shaft 12, between the inboard end 14 and the outboard end 16, to rotatably support the wheel end assembly 10 on the structure (not shown) of the vehicle. The wheel bearing 26 includes a knuckle attachment flange 28 that is adapted to connect the wheel end assembly 10 to the knuckle structure (not shown) of the vehicle. The knuckle attachment flange 28 has an inner diameter 30 that defines an inboard outer race 32 and an outboard outer race 34.

[0034] The bearing shaft 12 supports an inboard inner race 36 and an outboard inner race 38. A shown in figure 1, the inboard inner race 36 is a separate component mounted onto the bearing shaft 12 and the outboard inner race 38 is integrally formed within the bearing shaft 12.. Alternatively, the outboard inner race 38 can also be a separate component mounted onto the bearing shaft 12, as shown in Figure 2.

[0035] A plurality of bearing elements 40 are positioned within the wheel bearing 26. A first portion of the bearing elements 40 are positioned between the inboard

outer race 32 and the inboard inner race 36 and a second portion of the bearing elements 40 are positioned between the outboard outer race 34 and the outboard inner race 38. The bearing elements 40 allow the bearing shaft 12 to rotate relative to the knuckle attachment flange 28, thereby rotatably supporting the wheel end assembly 10 within the vehicle. The bearing elements 40 can be ball bearings, tapered bearings, or other suitable bearing elements, depending on the particular application.

[0036] The inboard end 14 of the bearing shaft 12 includes a flange portion 42. The flange portion 42 engages the inboard inner race 36 to provide a support for the wheel bearing 26 thereby keeping the wheel bearing 26 positioned on the bearing shaft 12 and inducing a pre-load into the wheel bearing 26. The flange portion 42 is formed by swagging a portion of the bearing shaft 12 over and against the wheel bearing 26. The flange portion 42 maintains a pre-load on the wheel bearing 26 when the outboard joint 20 is removed from the wheel end assembly 10.

[0037] As shown in Figure 1, the wheel hub 18 includes a brake rotor 44 having a braking ring 46 mounted thereon. As illustrated, the braking ring 46 and the brake rotor 44 are integrally formed with one another.

[0038] Referring to Figure 3, the wheel hub 18 includes a polygonal shaped inner bore 48 and the outboard end 16 of the bearing shaft 12 includes a correspondingly shaped polygonal hub 50 extending therefrom. The polygonal hub 50 of the bearing shaft 12 fits within the polygonal shaped bore 48 of the wheel hub 18 to rotationally lock the wheel hub 18 to the bearing shaft 12. A threaded fastener 52 axially secures the wheel hub 18 to the bearing shaft 12. Alternatively, the wheel

hub 18 and the bearing shaft 12 can be integrally formed with one another as a single component, as shown in Figure 2.

[0039] The outboard joint 20 includes a bell housing 54 having a narrowed neck portion 56 defining a bell housing inner surface 58. The bell housing inner surface 58 has a polygon shape and the bearing shaft 12 presents an outer surface 60 at the inboard end 14 that has a corresponding polygon shape. The bell housing inner surface 58 engages the bearing shaft outer surface 60 and is rotationally locked to the bearing shaft 12. A seal 62 prevents contamination from entering the constant velocity joint. As illustrated, the polygon shape of the bearing shaft outer surface 60 is formed within the flange portion 42 of the bearing shaft 12.

[0040] Referring to Figure 1, a notch 64 extends circumferentially around a portion of the polygon shaped outer surface 60 of the bearing shaft 12. As shown, the notch 64 includes two curved grooves cut into the polygon shaped outer surface 60 of the bearing shaft 12 and located approximately one hundred and eighty degrees apart. Referring to Figures 5 and 6, the bell housing 54 includes at least one window 66 formed within the narrowed neck 56. As shown, the bell housing 54 includes two curved windows 66 located approximately one hundred and eighty degrees apart and corresponding to the curved grooves of the notch 64. A retaining clip 68, shown in Figure 7, is inserted through the windows 66 and engages the notch 64 to secure the bell housing 54 to the bearing shaft 12, as shown in Figure 8. To remove the bell housing 54 from the bearing shaft 12, the retaining clip 68 must be removed.

[0041] Alternatively, the bell housing 54 can include a groove 70 extending around the bell housing inner surface 58, as shown in Figures 9 and 10. A retaining

ring 72, shown in Figure 11, is positioned within the groove 70 within the bell housing 54 and engages the groove 70 and the notch 64 of the bearing shaft 12 to secure the bell housing 54 to the bearing shaft 12, as shown in Figure 12. To remove the bell housing 54 from the bearing shaft 12, tangs 74 on the retaining ring 72 must be spread apart, such that the retaining ring 72 opens to a diameter larger than the notch 64 of the bearing shaft 12. This allows the retaining ring 72 to clear the notch 64 so the bell housing 54 can be removed.

[0042] Additionally, the polygonal shaped bell housing inner surface 58 and the polygonal shaped outer surface 60 of the bearing shaft 12 may be tapered at an angle along a longitudinal axis of the wheel end assembly 10, as shown in Figure 4. A tapered connection between the bell housing 54 and the bearing shaft 12 allows for a secure connection and reduces backlash between the two components.

[0043] Referring to Figures 13, 14, and 15 the bearing shaft 12 can also include a ring 76 mounted thereon. The ring 76 is positioned between the wheel bearing 26 and the flange portion 42 of the bearing shaft 12 and presents an outer surface 78. The flange portion 42 of the bearing shaft 12 secures the ring 76 onto the bearing shaft 12. The outer surface 78 of the ring 76 is polygonal shaped and corresponds to the polygonal shape of the bell housing inner surface 58, such that the bell housing inner diameter 58 engages the outer diameter 78 of the ring 76 to rotationally lock the bell housing 54 to the bearing shaft 12.

[0044] The polygonal shaped bell housing inner diameter 58 and the polygonal shaped outer diameter 78 of the ring 76 may be tapered at an angle along a longitudinal axis of the wheel end assembly 10. A tapered connection between the

bell housing 54 and the ring 76 allows for a secure connection and reduces the backlash between the two components.

[0045] As shown, the ring 76 includes a splined inner diameter 80 and the bearing shaft 12 includes a splined outer diameter 82. The spline of the ring 76 engages the spline of the bearing shaft 12 such that the ring 76 is rotationally locked onto the bearing shaft 12. Alternatively, the spline can be absent from the bearing shaft 12 wherein the spline of the inner diameter 80 of the ring 76 is press fit onto the outer diameter 82 of the bearing shaft 12, thereby rotationally locking the ring 76 onto the bearing shaft 12.

[0046] The ring 76 includes an inboard face 84 and the flange portion 42 of the bearing shaft 12 engages the inboard face 84 of the ring 76. Referring to Figures 16 and 17, the inboard face 84 of the ring 76 may include a plurality of axial extending ridges 86. The flange portion 42 of the bearing shaft 12 engages the axially extending ridges 86 to further secure the ring 76 and rotationally lock the ring 76 onto the bearing shaft 12.

[0047] Referring to Figures 14 and 15, a notch 88 extends circumferentially around a portion of the polygon shaped outer surface 78 of the ring 76. The notch 88 includes two curved grooves cut into the polygon shaped outer diameter 78 of the ring 76 and located approximately one hundred and eighty degrees apart. Referring to Figures 5 and 6, the bell housing 54 includes at least one window 66 formed within the narrowed neck 56. As shown, the bell housing 54 includes two curved windows 66 located approximately one hundred and eighty degrees apart and corresponding to the curved grooves of the notch 88. A retaining clip 68, shown in Figure 7, is inserted through the windows 66 and engages the radial notch 88 to

secure the bell housing 54 to the ring 76 and to the bearing shaft 12, as shown in Figure 8. To remove the bell housing 54 from the bearing shaft 12, the retaining clip 68 must be removed.

[0048] Alternatively, the bell housing 54 can include a groove 70 extending around the bell housing inner surface 58, as shown in Figures 9 and 10. A retaining ring 72, shown in Figure 11, is positioned within the groove 70 within the bell housing 54 and engages the groove 70 and the notch 88 of the ring 76 to secure the bell housing 54 to the bearing shaft 12, as shown in Figure 19. To remove the bell housing 54 from the bearing shaft 12, tangs 74 on the retaining ring 72 must be spread apart, such that the retaining ring 72 opens to a diameter larger than the notch 88 of the ring 76. This allows the retaining ring 72 to clear the notch 88 so the bell housing 54 can be removed.

[0049] The foregoing discussion discloses and describes the preferred embodiments of the invention. These embodiments have been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. One skilled in the art will readily recognize from such discussion, and from the accompanying drawings and claims, that changes and modifications can be made without departing from the scope of the invention as defined in the following claims.